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COLD ROOM TESTS OF THE EFFICIENCY OF THE
FINNISH PAPER EVACUATION BAG*

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ABSTRACT

COLD ROOM TESTS OF THE EFFICIENCY OF THE FINNISH PAPER EVACUATION BAG

OBJECT

To determine the protection against cold afforded by the Finnish Paper Evacuation Bag with particular reference to a comparison with the Quartermaster Bag, Casualty, Evacuation, Experimental (M-47). The ease of manipulation and durability under conditions of extreme cold were determined.

TEST

The efficiency of a single Finnish paper evacuation bag was tested during 7 simultaneous exposures of 2 normal subjects in the cold room at -40°C without and with wind averaging 15 miles per hour. While one subject was in the paper bag the other was either in no bag or in the Quartermaster bag. Both men wore a complete arctic clothing ensemble. Each walked for 1 hour on a treadmill before lying down in the standard supine position in a bag resting on 2 mattresses supported by a folding cot. Tests were terminated by a combination of subjective distress and low digital temperture or by the end of the working day for the man in the Quartermaster bag. In some tests the value of external heat was ascertained by placing hot water bottles around the extremities.

The same variables, measured on both men in all tests, included rectal temperature, skin temperatures at 16 points, temperatures inside the paper and Quartermaster bags, urinary output, time of onset of shivering, subjective reports of cooling, and tolerance time (the maximal interval in which the initially warm subject could cool in the supine position without risk of frost-bite). Observations were also made on the durability and difficulties of application of the 14 items in the paper bag assembly including body splints, limb bags, cordage and body wrapper. The paper assembly weighed 16 pounds as compared to 37 pounds for the Quartermaster bag.

RESULTS

The paper splints possessed mechanical strength, were light, and were easily applied to the body. The paper wrapper had considerable durability when dry. It lasted through 7 tests with careful handling, but easily fragmented when wet. Upon drying it regained its original strength. Some of the cords were unsatisfactorily weak; others were very strong even after soaking in water for 8 hours. Working under optimal conditions in the cold room, it took 2 observers 17 minutes to apply the splints and the wrapper and place the subject on a litter. These operations were performed by the

observers without incurring finger frostbites. The time required to place the subject in position in the Quartermaster bag (no splints) was negligible.

Tolerance time, without wind, was 3 hours in the paper bag as compared to 1.5 hours in no bag. In wind, the paper bag was of little value because wind ingressed along the right margin of the wrapper. One application of external heat (to prevent a fall in temperature or to rewarm the extremities) approximately tripled the tolerance time in the paper bag over that in no bag, even in the wind. Tolerance limits were not attained in the Quartermaster bag in these studies; previously, it was found that men could sleep in it overnight in the Arctic in comfort.

The rectal temperatures changed little in these tests. Only the digital skin temperatures fell to low values, and their initial fall could be as rapid, and the subjects could feel initially as cool, in the Quartermaster bag as in the paper bag or in no bag. This was due to the fact that the bags were always cold at the start of the test and it took 2 to 3 hours for the Quartermaster bag to warm up.

The onset of shivering was not significantly delayed by the paper bag beyond that in no bag. There was no shivering in the Quartermaster bag or in the paper bag with external heat.

Cold diuresis often occurred in these tests, and becomes the limiting factor in the Quartermaster bag and in the paper bag plus external heat.

CONCLUSIONS

It is concluded that (a) the paper bag is of definite value in protecting against dry still cold—the tolerance time in the bag assembly was double that with no bag; (b) it is of little or no value in dry windy cold; and (c) the protection that is afforded by the paper bag is not at all comparable to that afforded by the Quartermaster bag.

The paper splints appear to possess desirable qualities--light weight, low heat conductivity, adequate strength, and easy application.

The attractive qualities of the paper assembly—low cost, light weight and smaller bulk than the Quartermaster bag—are offset by its low durability when wet and its relatively low increment of insulation to the clothed body.

RECOMMENDATIONS

The development of an emergency evacuation kit of light weight and size, and consisting of perhaps the equivalent of the Finnish paper splints, external heat source, and an impermeable casing with a face cone might be given consideration.

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COLD ROOM TESTS OF THE EFFICIENCY OF THE
FINNISH PAPER EVACUATION BAG

I. INTRODUCTION

In a letter from the Medical Research and Development Board it was requested that the paper evacuation bags used by the Finnish Medical Department be tested for efficiency in the cold room at -40° without and with wind, using tests comparable to those used for the Quartermaster casualty evacuation bag. The only information forwarded about the test items was that found in 2 paragraphs in an enclosed copy of MIS report #815-600, which was based on a personal interview with the Chief of the Medical Service, Finnish Defense Forces, as follows:

> "In winter it is necessary that the wounded be protected from the cold by use of hay, straw, evergreen boughs, etc., in the bottom of the sled and by being wrapped in at least three woolen blankets of sheepskin cover. In addition, a sleeping bag made of many layers of heavy brown wrapping paper affords very good protection against wind and snow. It is necessary to protect the wounded part of the body with additional covers or a "limb" bag made of heavy wrapping paper. From the battalion advanced dressing station, where the patient generally receives his first medical care, evacuation to the rear is performed on a stretcher, by horse or auto. A mattress made of several layers of wrapping paper on the stretcher is very effective protection against cold."

> "...... It is interesting to note that the FINNS consider paper wrappings a necessity in addition to blankets for the protection of wounded against extreme cold temperatures ...."

In the absence of technical information, it was necessary to coin nomenclature and to make reasonable guesses as to how the several items were intended to be used. Only one paper bag was available for testing.

II. TESTS

A. Procedures

Two test subjects were used for the entire test series. They were soldiers with the following measurements: subject A, 27 years old, 141.8 pounds, 70.5 inches; subject B, 22 years old, 156.2 pounds, 67.3 inches. Operations in the cold room were described in running comments by the observers over the intercommunication system to the recorder in the control room, who indicated the time of each notation. In this way information was accumulated on damage to equipment, difficulties of manipulation, time required for the individual operations, etc.

All tests were performed in the cold room with air temperature at -40°C, without or with wind generated by a fan providing a wind velocity of 20 miles per hour at the head end and 10 miles per hour at the foot end or

an average of about 15 miles per hour over the entire body. One subject was in the paper bag, the other was either in no bag or in the Quartermaster Bag, Casualty, Evacuation, Experimental (M-47) on 2 layers of mattressing supported by a folding cot. (See Figure 1).

Upon entering the cold room, the subjects, fully dressed in arctic clothing (see Appendix A) and with thermocouples in place, walked on the treadmill on the level at 3 miles per hour for 1 hour with no wind. They then lay down and rested supinely with legs extended and arms alongside the body (see Figure 2) and the necessary applications were made to inclose the subjects in their respective bags. When no bag was used the subject lay in his clothing in above position with the ruff of the parka closed over the face for the duration of the test. When the Quartermaster bag was used it was simply zipped shut about the subject. In the paper bag tests the ruff of the parka was closed as much as possible over the face, the limb splints were tied, the accessory limb bags were applied and the body splints and wrapper and face envelope were placed in position.

The Quartermaster bag, the paper items, and the mattresses were at ambient cold room temperature at the time the warm subjects lay down. Thermocouple measurements were made of air temperatures at the level of the cots, at 8 points in the Finnish bag and at 3 points in the Quartermaster bag. The temperature at each point was registered every 6 minutes on a Brown recording potentiometer throughout the duration of the test run.

Skin temperatures were recorded continuously from the moment the subjects entered the cold room. Thermocouples were placed bilaterally; on the great toes, anterior and posterior thighs, middle fingers and lateral forearms; unilaterally, on the right side to the buttock, lower and upper back, abdomen and chest and to the middle of the forehead. (See Figure 3). The thermocouples were fixed by 1 layer of surgical tape. Temperatures were registered every 1-1/3 minutes on a Brown recording potentiometer. Rectal temperatures were measured before and after the cold room exposures using clinical thermometers.

The subjects at regular time intervals of 5 to 10 minutes reported, through throat microphones and the intercommunication system, their subjective estimate of cooling for the right and left toes, heels, thighs, fingers, forearms, buttocks, lower back, abdomen, chest and face. They judged the part as being warm, cool, cold, painful, stinging, hurting, burning, throbbing or numb. (See Figure 3). They also reported the presence or absence of shivering and, when shivering was present, judged its magnitude as being mild, moderate or intense.

Tests were terminated by one of three limiting factors: (1) a combination of subjective distress and a digital temperature close to 0°C (physiological tolerance time), or (2) by an intense desire to void urine or (3) by the end of the working day.

The subjects voided urine before entering and upon coming out of the cold room; the volumes and specific gravities were measured. In a control run the subjects lay for 6 hours on cots and mattresses in an air-conditioned room at 23°C. They wore fatigue clothing and each was covered

FIG. 1. View of the set-up during testing. The Quartermaster bag is on the left, the Finnish paper bag on the right. Both bags rested on 2 layers of mattressing. A fabric cone covered the face of the subject in the Quartermaster bag and a paper envelope covered the face of the subject in the paper bag. The cord to bind the foot flap shut had to be used to bind the paper wrapper from the side because one of the side cords had slipped out. The ruffling of the paper wrapper by the wind is evident.

FIG. 2. Subject lying in standard position ready to be wrapped in paper bag. This picture also shows the way in which hot water bottles were placed in the environs of the extremities in test 3. (See Table 1).

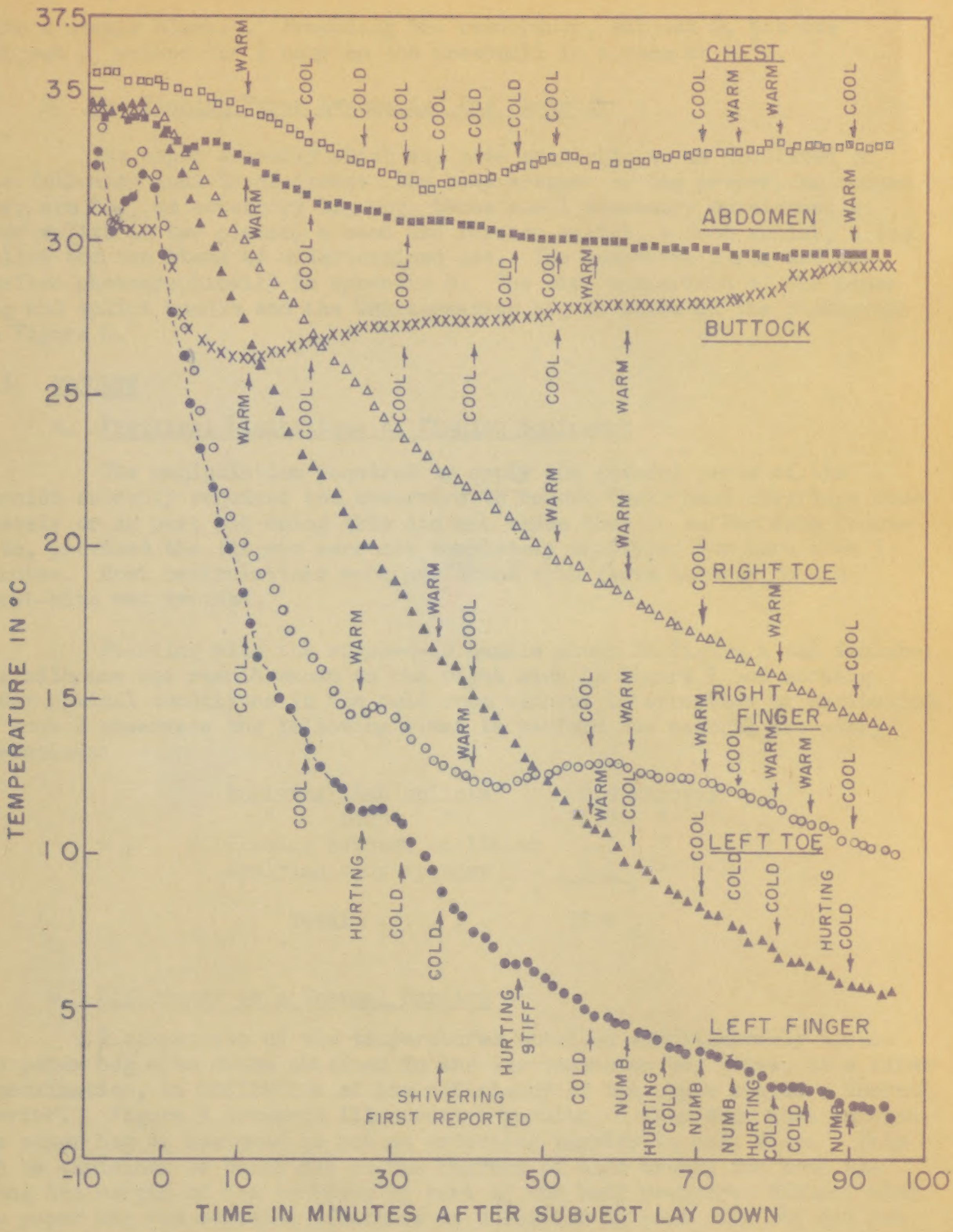

FIG. 3 COURSES OF SKIN TEMPERATURES OF SELECTED POINTS FOR SUBJECT A IN THE PAPER BAG WITH WIND (TEST NO. 6 TABLE I)

with a single blanket. Preceding the recumbency, subject B, but not subject A, walked for 1 hour on the treadmill in a room at 24°C.

B. The Finnish Paper Evacuation Bag Assembly

The paper assembly which was made available to us consisted of the following individual items: the body wrapper or bag proper, an accessory arm bag, an accessory leg bag, three small accessory envelopes, a body splint in two pieces, a hand and forearm splint, a foot splint, a leg splint and two items of undertermined use. The component parts are described photographically in appendix B. The size comparison of the paper bag and splint bundle and the Quartermaster bag is shown in the photograph in Figure 4.

III. RESULTS

A. Practical Limitations of Finnish Equipment

The manipulation required to apply the several parts of the Finnish assembly required the observers to remove their hand coverings completely or in part but doing this did not cause them to suffer from frost-bite, provided the fingers were not completely uncovered for more than 3 minutes. Most manipulations were performed with glove inserts on and frost-bite was avoided.

Starting with the wrapped-up bundle shown in Figure 4 and finishing with the end result shown on the right side in Figure 1 and working under optimal conditions in the cold room without interruption or hesitation, it took 2 observers the following times to perform the several necessary operations:

Applying limb splints	8.5	minutes
" body "	4.0	"
Placing subject on litter	1.5	"
Applying body wrapper	3.0	"
Total	17.0	"

B. Efficiency as a Thermal Barrier

A comparison of the temperatures obtained simultaneously within the paper bag with those obtained in the Quartermaster bag gives, to a first approximation, an indication of the efficiency of the paper bag as a thermal barrier. Figure 5 presents illustrative results. They show that in wind the paper bag as designed is not an effective barrier to heat flow. This can be explained as being due to the ingress of wind around the neck and along the margin of the overlapping part of the body wrapper. Without wind the paper bag was somewhat effective as a barrier to heat flow but did not approach the effectiveness of the Quartermaster bag. In this situation the paper bag maintained a gradient of 8 to 20 centigrade degrees, which was established in less than an hour. The variability was probably caused by "breathing" of ambient air (along the same passages where wind would enter) due to body movements. Although the temperature above the pubis was sometimes only a little below that in the Quartermaster bag in wind, the heat

FIG. 4. Size comparison of the paper and splint bundle and the Quartermaster bag. The former weighed 16 pounds, the latter 37 pounds.

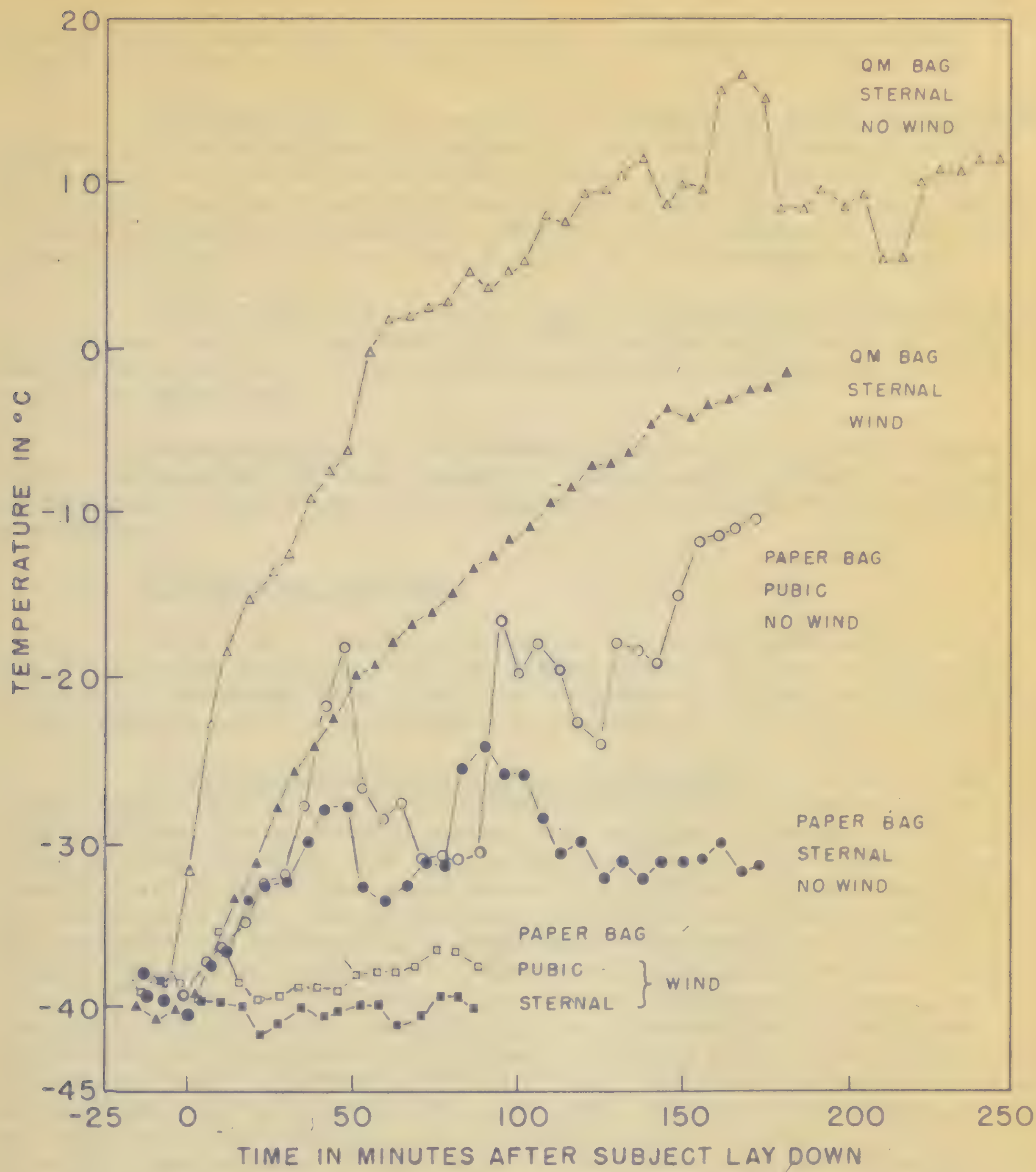

FIG. 5 TIME COURSE OF TEMPERATURES INSIDE QUARTERMASTER AND PAPER BAGS. THE THERMOCOUPLES WERE TAPED TO THE BAGS JUST ABOVE THE MID STERNUM AND THE PUBIS. THE TEMPERATURES IN THE PAPER BAG ABOVE THE STERNUM WITH WIND WERE APPROXIMATELY THE SAME AS AMBIENT AIR TEMPERATURE.

flow necessary to maintain this gradient in the paper bag was perhaps 2 to 3 times that in the Quartermaster bag.

The Quartermaster bag maintained a gradient of about 50 centigrade degrees in no wind and about 40 degrees in wind averaging about 15 to 18 miles per hour. Without the wind the gradient was established in about 2 hours; with wind the steady state had still not been reached after 3 hours. A certain amount of body cooling, therefore, can be expected to take place during the first 2 to 3 hours that a man is in the Quartermaster bag.

In all tests, bag or no bag, wind or no wind, the temperature on the mattress under the body rose above 0°C, even up to 20° to 25°C. Any hoar frost or ice present melted, although there was never enough water to weaken the paper bag.

Temperatures inside the accessory limb bags are shown in Figure 6. These limb bags were of value largely in wind where they brought the limb environmental temperatures close to those for the whole body when no wind was blowing.

C. Physiological Responses

Table 1 is a composite tabulation of the test runs made with no bag and with the paper bag, with and without wind. The data in this table, coupled with accessory data taken from the protocols of the individual tests, reveal several points of practical and physiological significance or interest.

1. Protection afforded against extreme cold. There was a definite limit in the time which the subjects were able to tolerate the test conditions when the protection against cold consisted of arctic clothing alone or arctic clothing plus the Finnish paper bag. Physiological tolerance time was the duration of the maximal interval during which the initially warm subject could cool in standard position without risk of frost-bite. The end-point was indicated by a combination of subjective distress and a digital temperature close to 0°C. When there was no wind the added protection of the paper bag doubled the physiological tolerance time over that for the arctic clothing alone; specifically the tolerance time in the former instance was 1.5 hours and in the latter instance 3 hours. In the presence of wind the paper bag afforded little, if any, additional protection over the arctic clothing; the tolerance time for arctic clothing alone being 1.4 hours and that for arctic clothing plus the paper bag was 1.6 hours. It is to be noted that the presence of wind caused a just perceptible reduction in tolerance time when the subject's only protection against cold was the arctic clothing. It is reasonably certain that the failure of the paper bag to give added protection in wind was due to the ingress of cold air under the paper wrapper (see Figure 1) due to the fact that the free end of wrapper was not long enough to be closed properly.

In striking contrast to the limited physiological tolerance time for the paper bag the same subjects experienced no equivalent intolerance to the same test conditions when, in addition to the arctic clothing, they were protected against the cold by the Quartermaster bag. The duration of the tests with this bag ranged only from 3 to 4.5 hours,

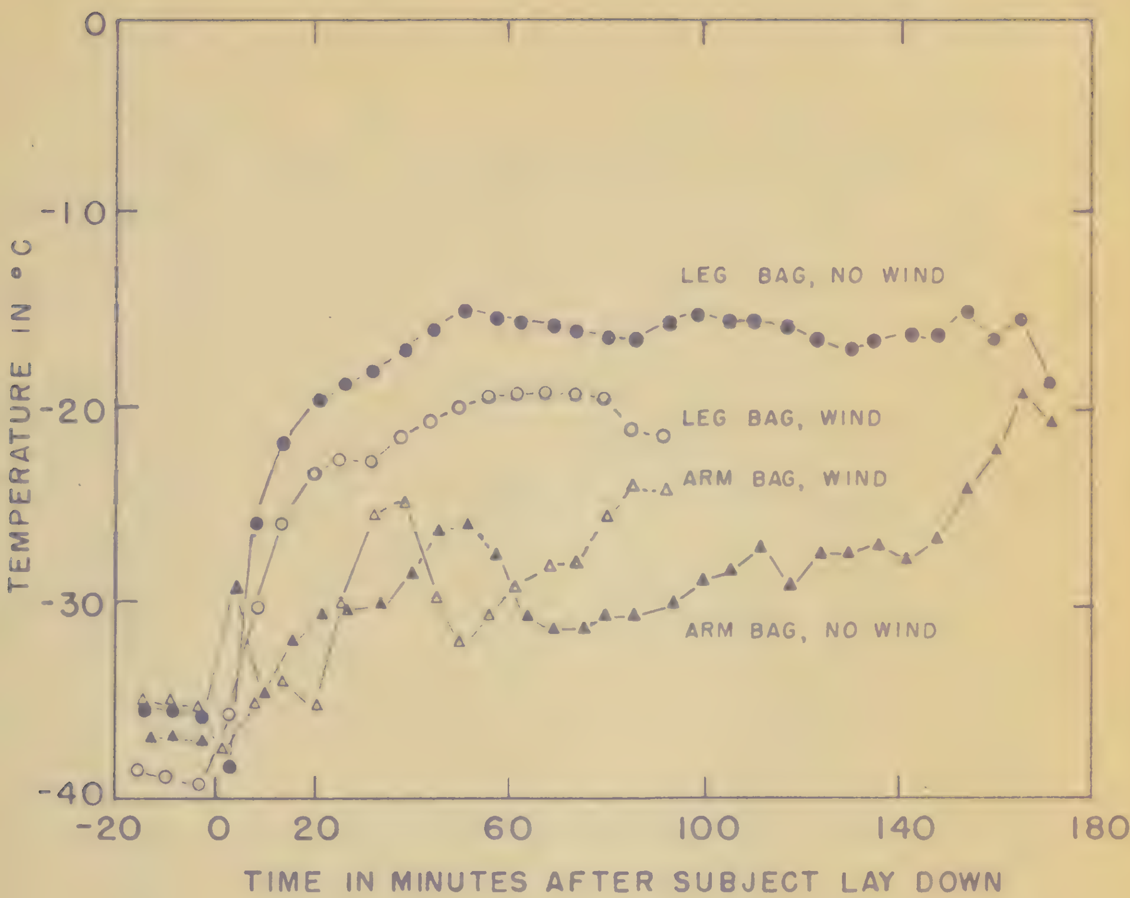

FIG. 6. TIME COURSE OF TEMPERATURES INSIDE OF ACCESSORY LIMB BAGS. THE THERMOCOUPLES WERE TAPED TO THE LATERAL WALLS NEAR THE DISTAL END.

TABLE 1

TOLERANCE TIME AND ONSET OF SHIVERING IN HOURS OF RECUMBENCY

CONDITION	TEST NO.	SUBJECT	LIMITING DIGITAL TEMP.	TOLERANCE	ONSET OF SHIVERING
			°C	Hours	Hours
NO WIND					
Paper Bag (1)	1	A	0.0 left toe	3.05	1.12
" "	2	B	3.3 left toe	2.95	1.23
Paper Bag & HWB (2)	3	B	—	4.27 (3)	Did not Shiv
No Bag	4	A	0.3 left finger	1.51	1.28
" "	5	B	-0.6 right toe	1.58	0.66
WIND					
Paper Bag (1)	6	A	1.6 left finger	1.61	0.61
" "	7	B	2.4 left toe	1.95 (4)	0.30
Paper bag with limb splints	8	B	0.6 right toe	3.04	0.46
Paper Bag & HWB (2)	9	A	—	4.34 (3)	1.90
No Bag	10	A	0.4 left toe	1.38	—
" "	11	B	-0.5 both toes	1.42	0.44
No Bag & HWB	12	A	0.8 left toe	1.71	0.45

(1) In tests 2,6 and 7 the accessory bags were applied to the right arm and leg; in tests 1 and 3 only the arm bag was used; in tests 3 and 4 no limb bags were used.

(2) With 3 hot water bags tied to feet and 3 across hips under hands; cf. Fig. 18.

(3) Terminated by extreme desire to void urine.

(4) One hot water bottle was placed under the heels and one under each hand at 1.66 hours, at which time the subject was anxious to terminate the test.

nevertheless, it is essentially certain that it would afford indefinite protection against a low temperature of the extremities and the subjective distress associated therewith.

The main limiting factor in physiological tolerance time encountered with the arctic clothing and paper bag proved to be low digital temperatures. The fact that it was the extremities which were vulnerable to frost-bite rather than other parts of the body is readily evident from the skin temperature curves shown in Figure 3. The final limiting digital temperature which was obtained for each test is given in Table 1. The fact that low digital temperatures were the predominant limiting factor in the overall subjective discomfort syndrome was effectively demonstrated in the test run where the lowering of the temperature of the extremities was prevented by application of hot water bottles. (See Figure 2 and Table 1). This procedure increased the tolerance time from 3 to 4-1/4 hours and then the limiting factor was an entirely new and/or different element--the discomfort of a full bladder due to cold diuresis.

From the standpoint of skin temperature it was impossible to evaluate the protection afforded by the accessory limb bags. This was due directly to the variability in the skin temperatures of the two corresponding extremities or digits under identical test conditions. (See Figure 3.) Thus, in some tests, the right limbs encased in the accessory paper bags showed higher skin temperatures than did the left limbs not encased in accessory bags; in other like tests, the skin temperatures of the corresponding limbs did not exhibit significantly different readings.

2. Skin temperatures. As alluded to above, in general only the digital skin temperatures showed a marked or significant fall. (See Figure 3). No definite correlations could be made between digital and trunk skin temperatures.

The courses of subject A's left finger temperature in the Quartermaster bag, in the paper bag and in the arctic clothing alone all without wind are shown in Figure 7 and in Figure 8 for subject B, with wind. There was an initial fall in temperature under all conditions for both subjects. In the Quartermaster bag the fall was arrested after about 1 hour and subsequently there was a spontaneous rewarming of this part. In the tests with no bag and the paper bag a most interesting phenomenon of abrupt spontaneous rewarming occurred in subject B but not in subject A. In one test (number 8 in Table 1) this spontaneous digital rewarming significantly prolonged subject B's physiological tolerance time, as shown in Figure 9. When the right finger temperature had dropped to 0.8°C the test had run 102 minutes, and it was decided to terminate this test. Before the decision could be acted upon both finger temperatures suddenly rose. The test was finally stopped when the right toe reached 0.6°C, although had the test continued this toe may also have warmed spontaneously. Because of this phenomenon of spontaneous warming-up of digital temperatures the tolerance time was twice prolonged significantly.

3. Shivering. Except for occasional bouts of strenuous movement, shivering appeared to be only moderate in all tests in which it occurred. It was never reported to be present in the Quartermaster bag and it was practically abolished in the paper bag by the use of hot water bottles.

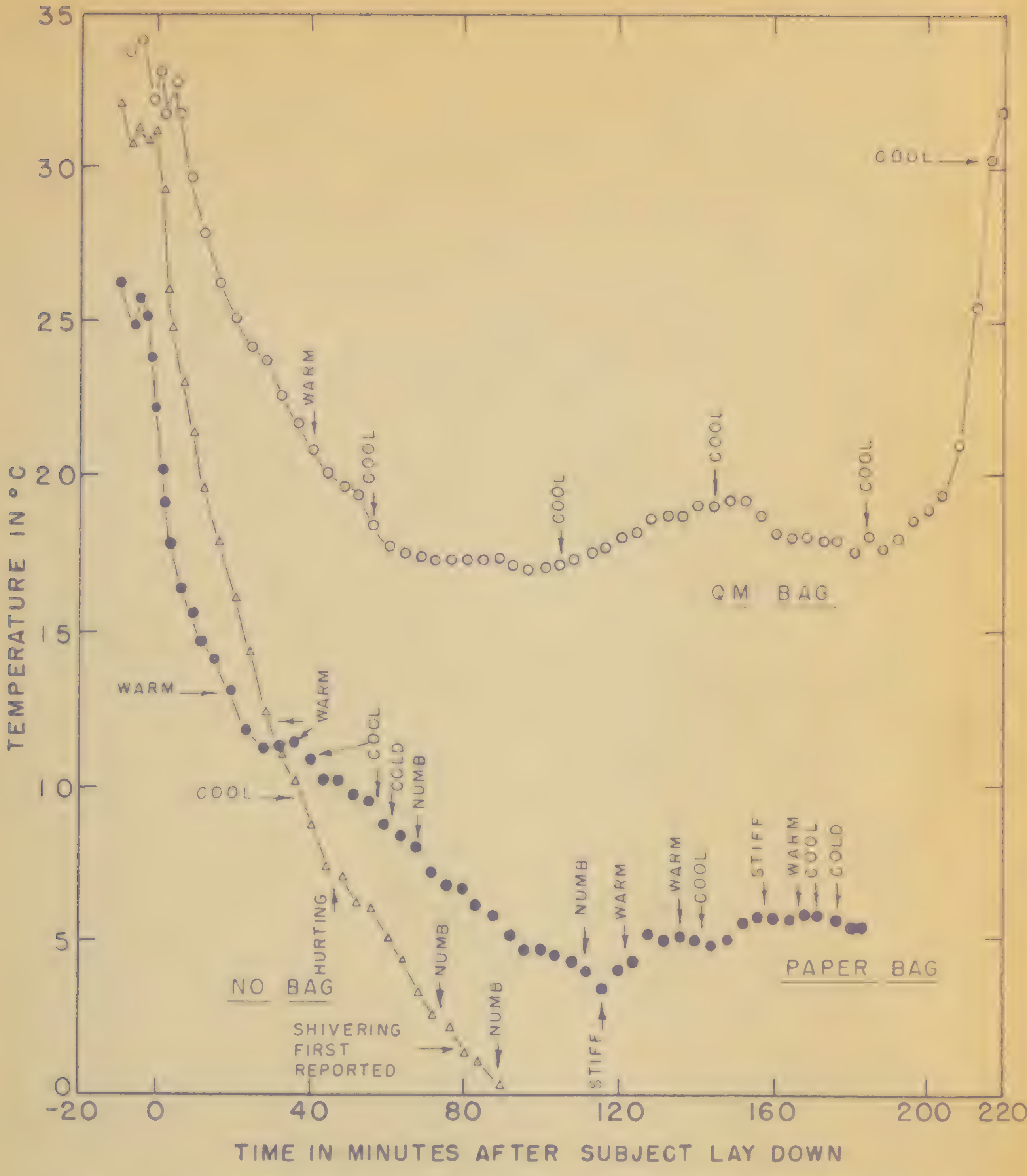

FIG. 7 COURSES OF LEFT FINGER SKIN TEMPERATURE UNDER THREE CONDITIONS IN NO WIND FOR SUBJECT A.

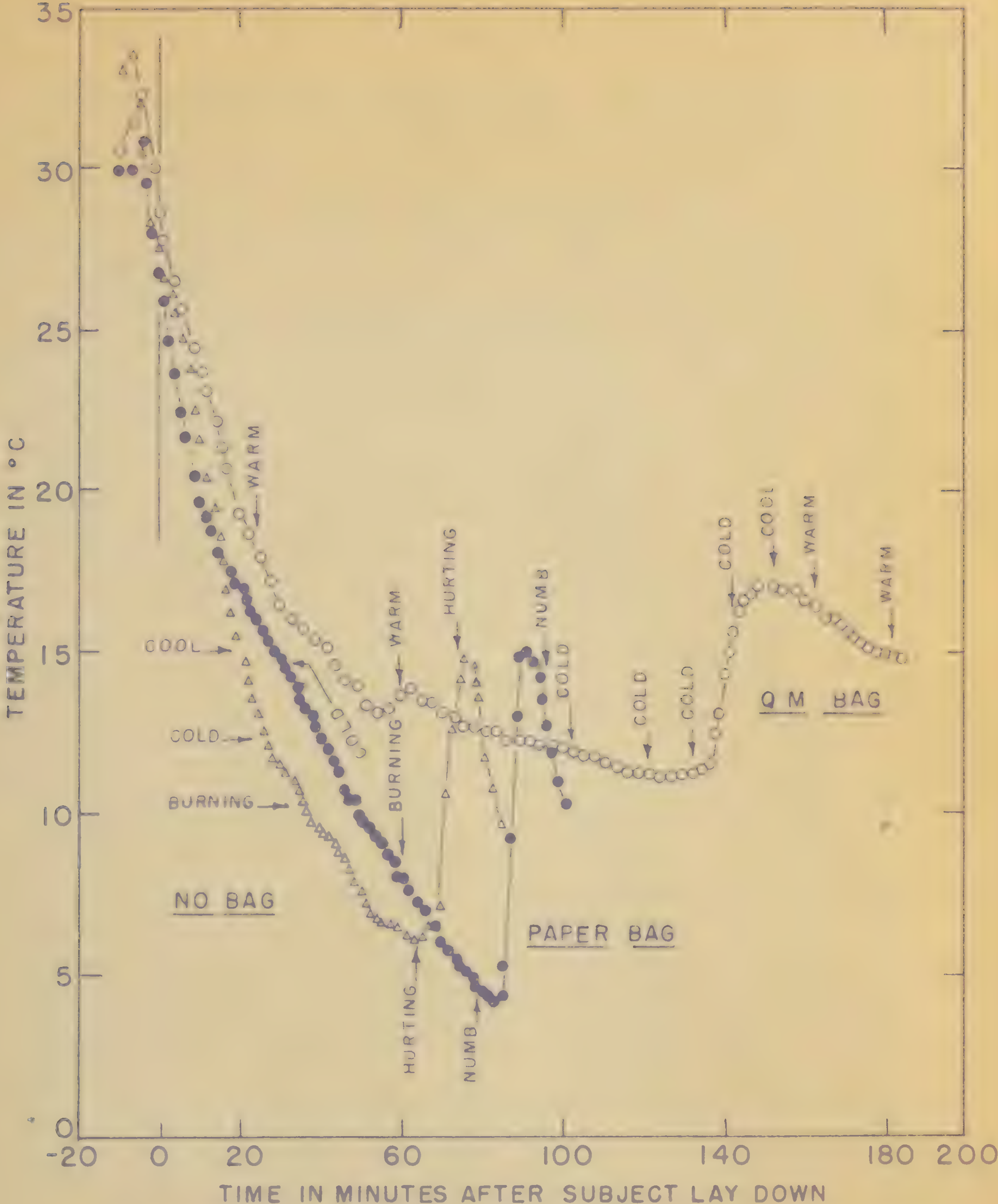

FIG. 8 COURSES OF LEFT FINGER SKIN TEMPERATURE UNDER THREE CONDITIONS IN WIND FOR SUBJECT B.

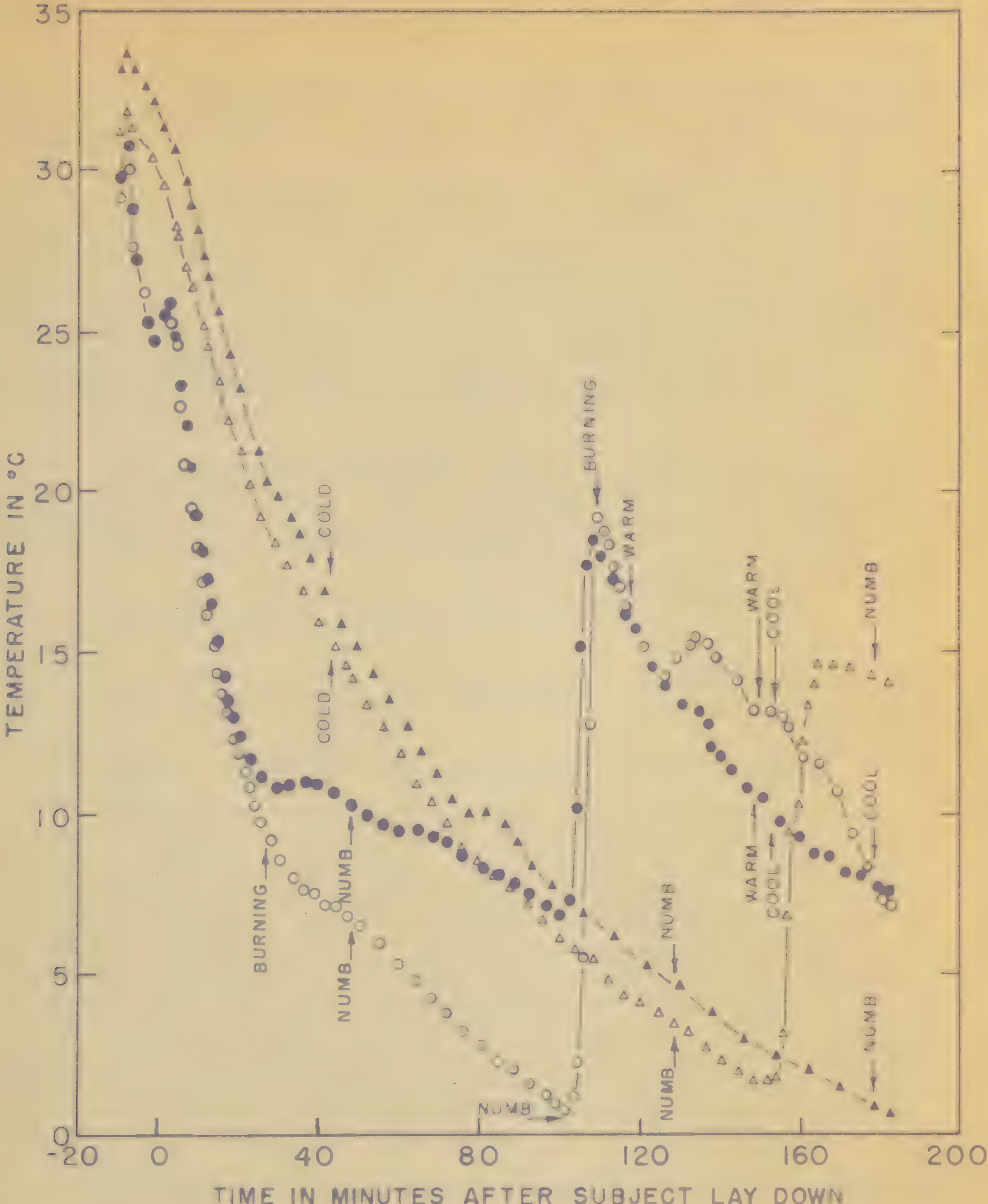

FIG. 9 COURSES OF DIGITAL SKIN TEMPERATURES OF SUBJECT B IN PAPEB BAG WITH SPLINTS IN WIND (TEST NO. 8 IN TABLE I).

○ = RIGHT FINGER ▲ = RIGHT TOE
● = LEFT FINGER △ = LEFT TOE

As shown in Table 1, the onset of shivering was not significantly delayed by the paper bag beyond that in no bag.

4. Rectal Temperature. The rectal temperature changes were too small to be informative and showed no correlation with the type of bag or environmental conditions. The changes were in the range of $\pm$ 0.3°C.

5. Urinary Output. A definite cold diuresis occurred in both subjects irrespective of the type of bag or amount of wind. Per unit of time the magnitude of the diuresis was roughly the same for all tests for each individaul subject. This was particularly true of subject B as is readily evident in Figure 10. Thus, when the limiting factors associated with low extremity temperatures were avoided, the full bladder became a new limiting tolerance feature. It is of practical importance and of considerable physiological interest to note that the Quartermaster bag did not protect against cold diuresis. (See Figure 10).

6. Temperature Sensations. Digital temperatures usually had to be below 15°C before they felt cold and below 10°C to feel numb. Non-digital areas could feel cold before temperatures were below 30°C for the trunk and 20°C for other parts. (See Figure 3).

When right and left sides differed in temperature they could often be differentiated subjectively.

There seemed to be a lag between a change in temperature and the associated change in subjective reporting.

D. Ease of Manipulation and Durability of Paper Assembly

The paper wrapper, or bag proper, had considerable durability when dry as shown by the fact that it lasted 7 rather formidable tests--with careful handling, to be sure. It easily fragmented when wet; upon drying it regained its original strength. During the test hoar frost and ice melted on the under side of the wrapper but some of this moisture was absorbed by the mattresses. In one test in which some water leaked out of a hot water bag the water simply froze on the paper and caused no damage. Tearing was held to a minimum because of the care in handling. The wrapper was easy to apply or wrap about the subject after splints and/or accessory bags were in place. As alluded to elsewhere, in its present design the closure of the bag is inadequate permitting the ingress of air, particularly when wind is present. Some of the cords were unsatisfactorily weak; others were very strong, even after soaking in water for 8 hours.

The paper splints possessed mechanical strength, were light and easily applied.

IV. DISCUSSION

In spite of the facts that only one paper bag assembly was available for testing and we were unable to measure the subjects' heat production other than as indicated by the presence or absence of shivering, the practical differential conclusions drawn are clear cut and need no qualifications. Nevertheless the extreme limitations of the test situation should

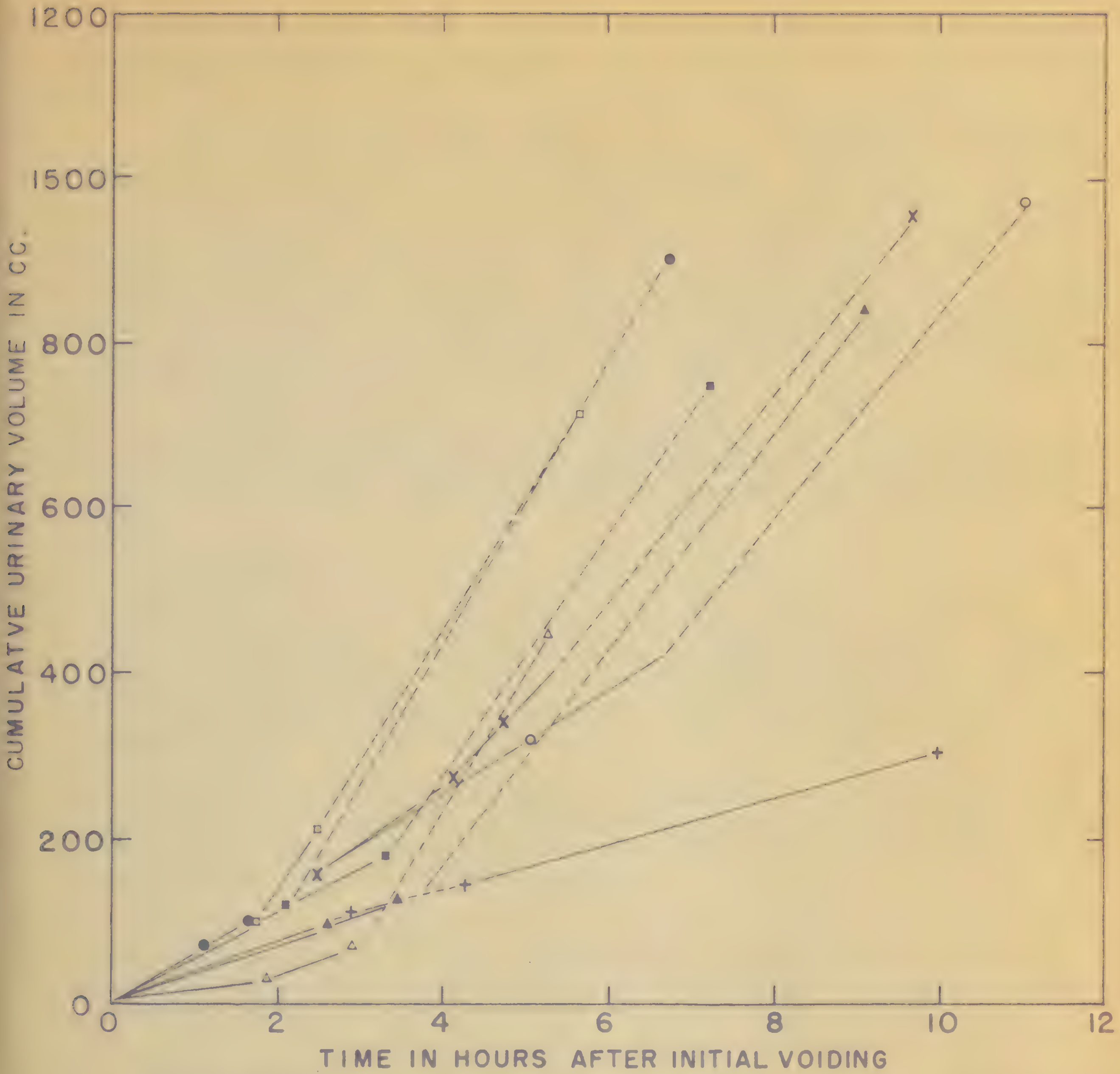

FIG. 10 URINARY OUTPUT OF SUBJECT B. HE WAS IN THE COLD ROOM DURING THE DASHED PORTIONS OF THE CURVES.

+ = CONTROL RUN
● = PAPER BAG, NO WIND
○ = QUARTERMASTER BAG, WIND
■ = PAPER BAG, WIND
□ = NO BAG, NO WIND
▲ = PAPER BAG WITH HOT WATER BAGS, NO WIND
△ = NO BAG, WIND
x = PAPER BAG WITH SPLINTS, WIND

be constantly kept in mind. For instance, there might be danger in certain aspects in attempting to carry over the conclusions drawn from these tests to field and, particularly, casualty circumstances.

The protection afforded against cold is so strikingly in favor of the Quartermaster bag that it would hardly seem that consideration of use of the paper assembly would be even remotely eminent. However, in the event a situation did arise where a differential in weight and bulk was a primary factor, there are certain obvious improvements which could be made to the Finnish assembly. These would be (1) increase in size of wrapper so as to allow the loose end to terminate underneath the subject to effect a closure which would prevent the ingress of cold air, (2) add to the assembly an impermeable casing with a face cone which would protect the paper components against wetting, as well as the ingress of wind.

The desirability of the immediate application of external heat, particularly placed in the environ of the extremities for the paper bag as well as the Quartermaster bag, is readily evident from the results obtained in these tests.

V. CONCLUSIONS

The Finnish Paper Evacuation Bag is of definite but limited value in protecting against dry still cold. It is of little or no value, in its present design, in wind. The protection afforded by the paper bag is not at all comparable to that afforded by the Quartermaster Bag, Casualty, Evacuation, Experimental (M-47).

The limiting physiological factor in tolerating extreme cold in the paper bag is a low temperature of the extremities. Tolerance time in the paper bag can be markedly increased by the application of external heat to the immediate environs of the extremities.

When low digital temperature is eliminated by application of external heat, the discomforts of a full bladder due to cold diuresis becomes a limiting factor. The Quartermaster bag, under the test conditions used, also does not protect against cold diuresis.

VI. RECOMMENDATIONS

The development of an emergency evacuation kit of light weight and size, and consisting of perhaps the equivalent of the Finnish paper splints, external heat source, and an impermeable casing with a face cone might be given consideration.

APPENDIX A

ARCTIC CLOTHING WORN BY EACH TEST SUBJECT

1. Sock, wool, cushion sole, 1 pair
2. Sock, wool, ski, X81, 2 pairs
3. Sock, felt, 1 pair
4. Insole, felt, 2 pairs
5. Mukluk, X81, 1 pair
6. Glove, insert, wool, X81, 1 pair
7. Glove, shell, leather, X81, 1 pair
8. Mitten w/liner, X81, 1 pair
9. Undershirt, X81, 1 each
10. Drawer, X81, 1 pair
11. Shirt, wool, 1 each
12. Sweater, wool, highneck, 1 each
13. Trouser, outer, X81, 1 pair
14. Parka, outer, X81, 1 each

APPENDIX B

COMPONENT PARTS OF FINNISH BAG ASSEMBLY

FIG. 11. The body wrapper rolled up. It weighed 4 pounds. When dry the wrapper had considerable strength and durability; when wet it easily fragmented but regained its original strength with drying.

FIG. 12. Inner aspect of the body wrapper, the paper bag proper. It was made of 3 layers of crepe paper with a sheet of heavy smooth paper down the part where the body rested. A section was cut out for the head. The wider folded part on the right side of the picture was swung over the body and overlapped the narrower opposite margin. The cord segments for tying the wrapper around the body pierced the wrapper through the bottom section and ended in looped knots. These knots prevented slippage but could be easily pulled out.

FIG. 13. Outer aspect of the body wrapper. The foot flap cord referred to in Figure 1 can be seen at the bottom middle. These cords were a twist of 2 paper ribbons each $1\frac{1}{2}$ inches wide. The cords could be easily torn and when wet were of no value.

FIG. 14. Accessory bags for the arm (left) and leg (right). Each consisted of an outer and inner paper bag with intervening insulation made of 9 laminae of crepe batting. The leg bag was frayed during the first test by the heel due to shivering movements. It was patched up with tape but became completely unusable after 2 more tests. The arm bag also eventually frayed at the elbow and orifice margin. Only the leg bag had a cord, which was simply tied through a hold and was easily pulled off. It was unsatisfactorily weak being made of only a twisted paper ribbon 1-1/16 inches wide.

FIG. 15. Accessory envelopes. Each was made of 2 layers of crepe paper. The 6-inch rule on the right one indicates size. Only the middle one was tested by using it as a cover for the face over the parka ruff. The cords were weak; each was made of a twisted paper ribbon 1-1/16 inches wide.

FIG. 16. The 2 halves of the body splint. The upper half is on the right and the lower half is on the left. They were made of heavy cardboard stiffened by lateral strips of 8 mm. plywood. The upper ends of the strips of the lower half inserted snugly into the metal sleeves at the lower ends of the upper strips. The 2 halves were locked together by a small rectangular piece of plywood in the bottom middle of the upper half. It disintegrated during the first trial recumbency. The accessory cord at the top of the picture was used to tie the limb splints. It was 27.5 feet long and was made of 6 strands of twisted paper ribbon 3/4 inch wide. This cord was strong even after soaking in water for 8 hours.

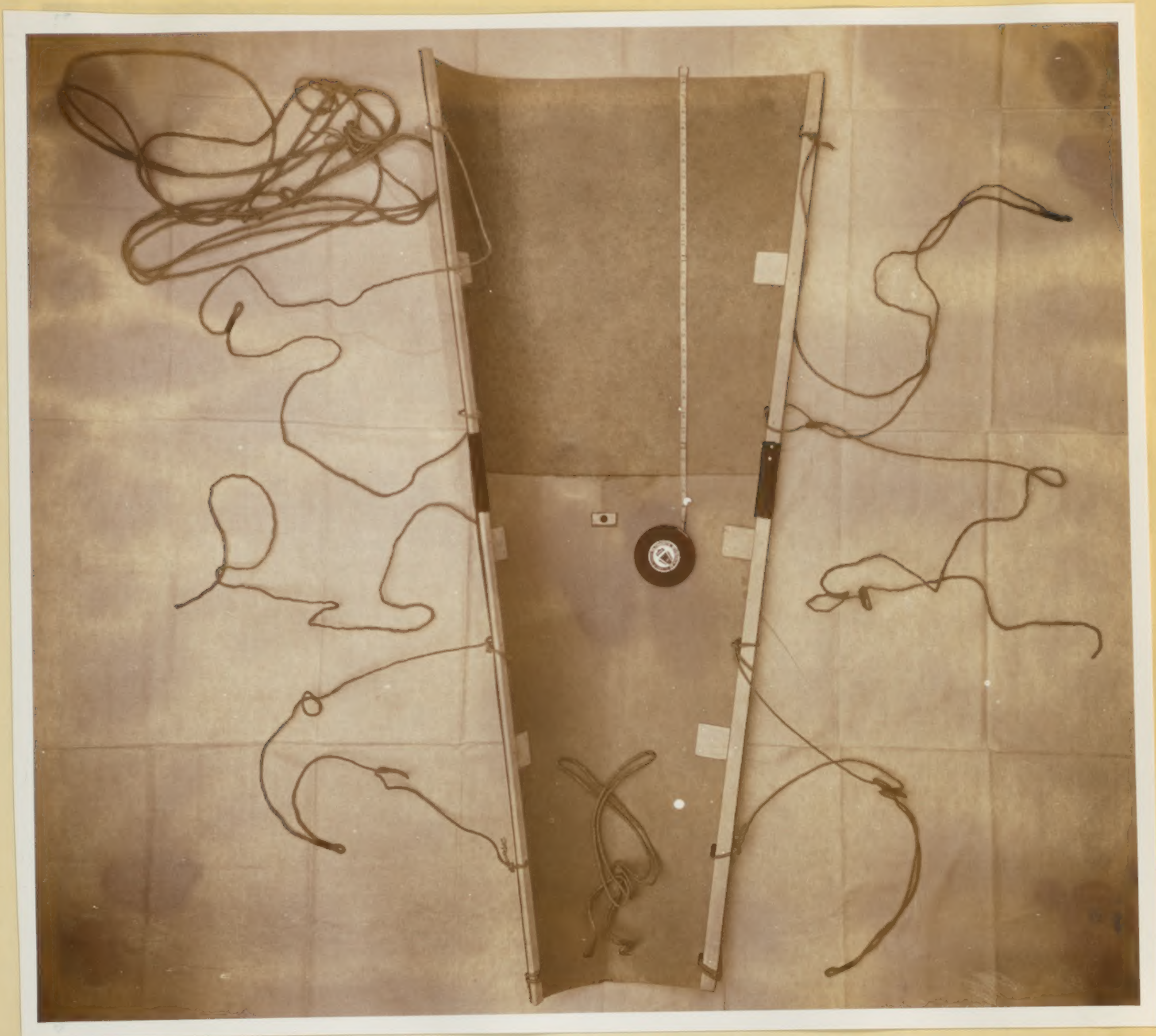

FIG. 17. Superior aspect of the assembled body splint. It extended from the armpits to the bottom of the heels. Three loops on one side were passed over the body and fastened to the other side. The 3 loops from this side in turn passed across underneath to reenforce the cardboard. The middle loops were actually formed only after assembly by tying the free end of each through a slot on the other half of the splint. The centers of these middle loops were not stiffened by metal sleeves as were those of the end loops and consequently they frayed with repeated use. The stiffened centers of the end loops served as probes to push through the slots and out laterally under the marginal squares of plywood. These squares were attached to the cardboard medially by 2 bent nails which exerted enough pressure to prevent slippage of the cords without tying. With repeated use the nails came through the cardboard.

FIG. 18. Inferior aspect of the assembled body splint. It carried the only provided directions which referred only to the body splint. They were translated for us by Sgt. Pauli Nysten of the A.F.F. Board No. 2. According to these directions, by means of a right-angled adaptor the upper half can be attached to the lower so as to give support in the sitting position. Since no adaptor was in the bundle, this possibility could not be tested. The Finnish term for the body splint is transportation splint. The cords were made of 5 strands, each of which was a twist of 2 paper ribbons each 11/16 inch wide. We did not succeed in figuring out a good use for the cord at the foot end. The weight of the body splint was 5 pounds.

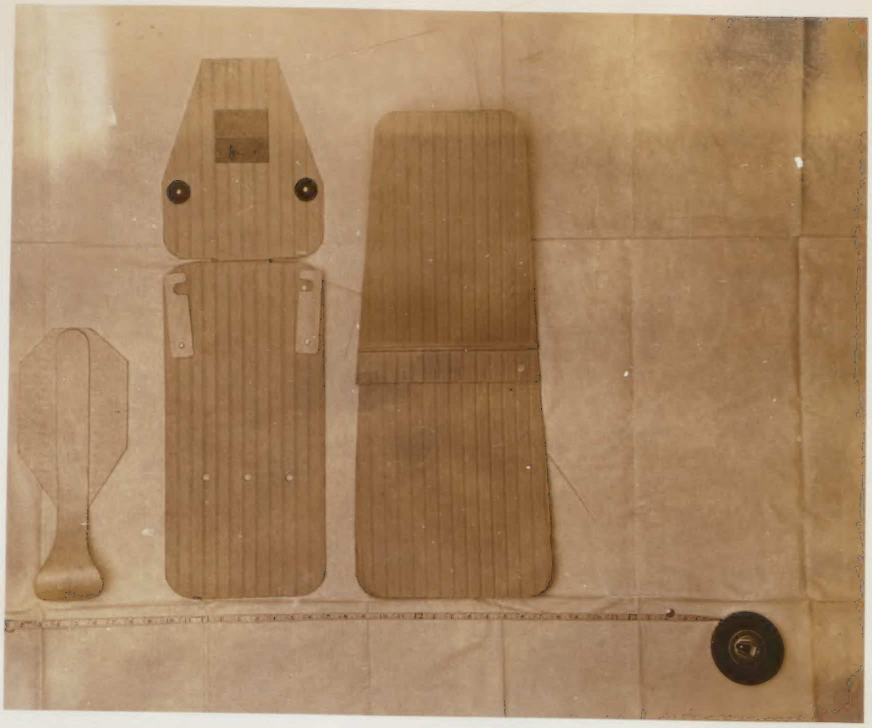

FIG. 19. Limb splints. On the left is the hand and forearm splint (4.4 ounces) made of plywood tacked to cardboard which could be easily rolled and tied to the forearm. The middle splint (12 ounces) was shaped into a foot splint as shown in Figure 20. The right splint (14.6 ounces) was used as a leg splint. It could be easily rolled and tied to the leg. The hinging across the middle permitted reduction in length. The longitudinal ribbing of these cardboard splints conferred both transverse flexibility and longitudinal rigidity.

FIG. 20. The formed foot splint. The cord served to re-enforce the wood angle braces.

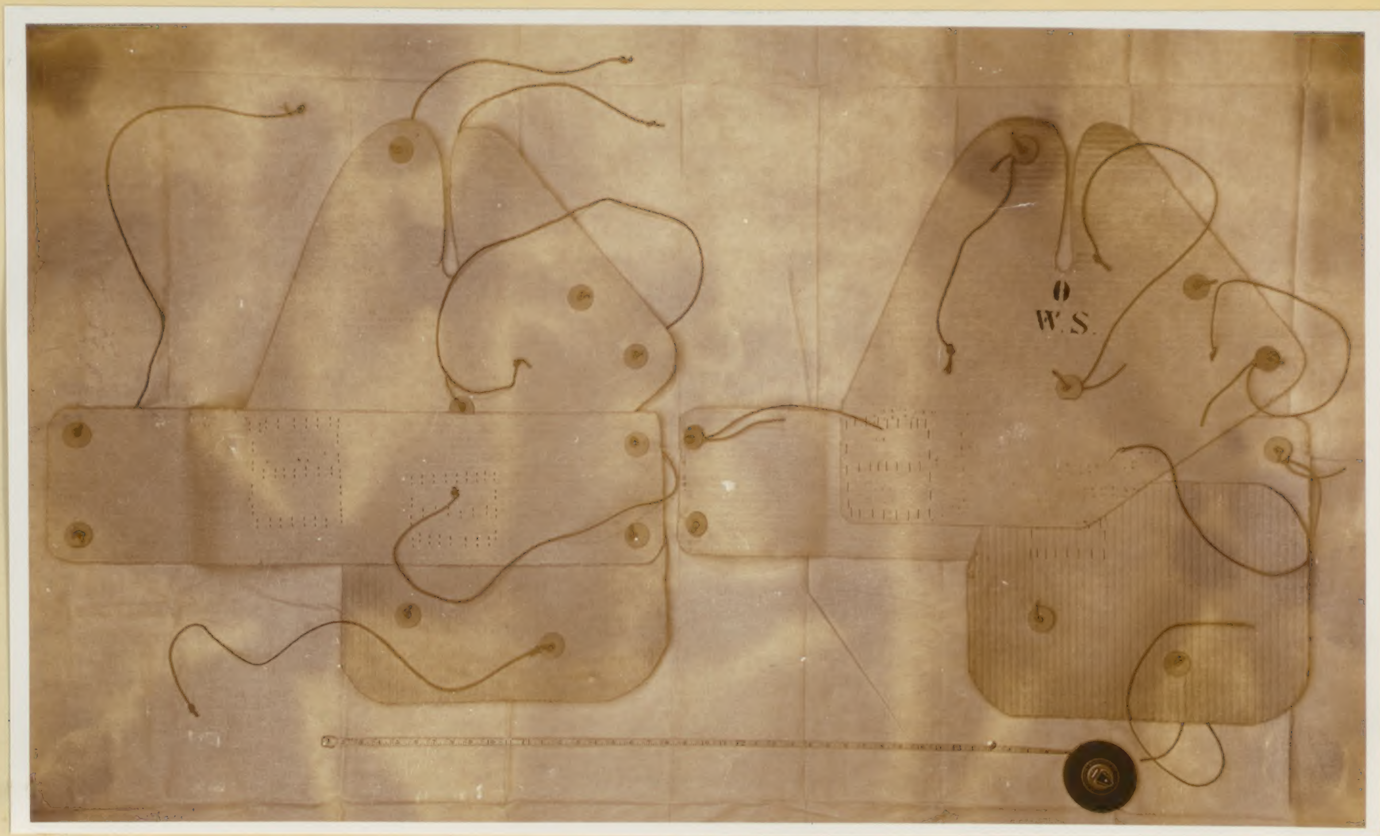

FIG. 21. <u>Two items of unknown use</u>. They were mirror images of each other and were obviously designed with great care for some definite purpose. Sgt. Nysten, who had served 17 years in the Finnish Army, was unable to offer a satisfactory solution. He had seen some of the other paper items used during the war but not these two. He said the letter O could indicate right and the letter L in the corresponding position on the reverse side of the left piece could stand for left. The letters W.S., however, baffled him becuase there is no W in the Finnish alphabet.

The material was laminated paper which was flexibly stiff but poorly water absorbing on the surface. The cords were strong; they were made of 3 strands, each in turn consisting of 3 strands of twisted paper ribbon about 3/8 inch wide.